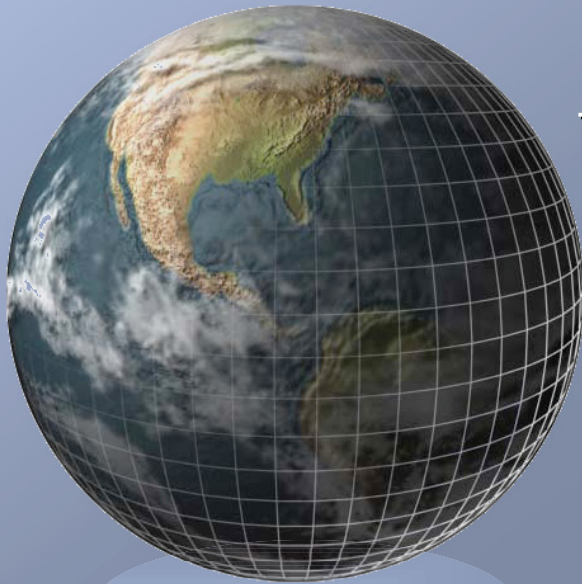


YEAR OF COORDINATED OBSERVING, MODELING AND FORECASTING: ADDRESSING THE CHALLENGE OF ORGANIZED TROPICAL CONVECTION



This proposed activity arose out of a recommendation by the THORPEX/WCRP/ICTP Workshop on Organisation and Maintenance of Tropical Convection and the MJO, held in Trieste in March 2006. It was presented at the WCRP/CLIVAR SSG Meeting in Buenos Aires in April 2006.

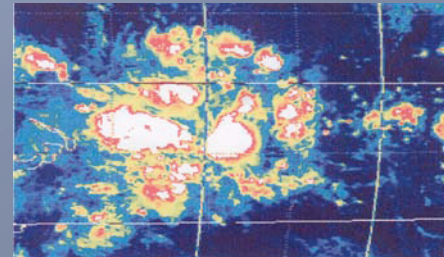
Based on positive feedback from the WCRP Director and the SSG, the SSG asked that the proposal be developed in cooperation with THORPEX, GEWEX, CEOP, AAMP, WGNE, WOAP, WMP, etc.

If implemented in 2008, this initiative could be a WCRP contribution to the UN Year of Planet Earth* and compliment IPY.

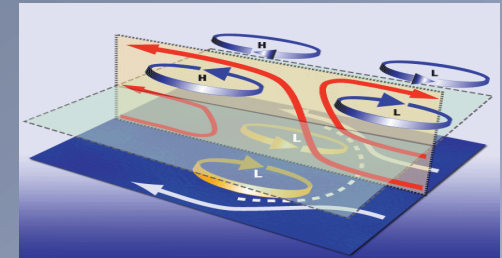
*January 5, 2006: The U.N. General Assembly, meeting in New York, proclaimed the year 2008 to be the U.N. International Year of Planet Earth. The Year's activities will span the three years 2007-2009 (www.yearofplanetearth.org/proclamation.htm).

THE MULTI-SCALE ORGANIZATION OF TROPICAL CONVECTION AND SCALE INTERACTION ARE GRAND CHALLENGES IN THE PREDICTION OF WEATHER AND CLIMATE:

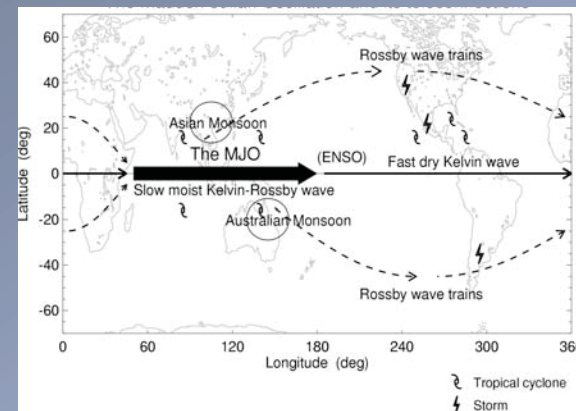
- HOW IS ORGANIZED CONVECTION INFLUENCED BY, AND FEEDBACK TO, THE LARGE-SCALE CIRCULATION?
- HOW DOES LARGE-SCALE DYNAMICS AND MESOSCALE CONVECTIVE ORGANIZATION INTERACT?
- HOW DOES LARGE-SCALE TROPICAL CONVECTION INTERACT WITH THE EXTRA-TROPICS?



Supercluster: a family of organized convective systems



Mesoscale – Supercluster scale -interaction (Moncrieff 2004)

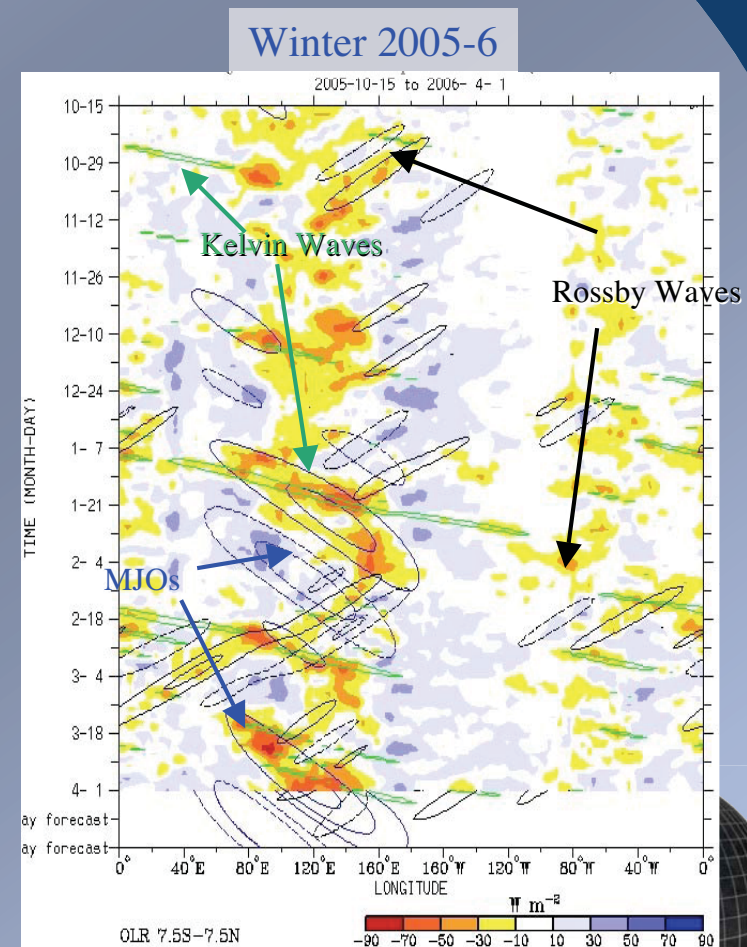


Global effects of organized tropical convection (J .Lin, NOAA/CDC)



OUR SHORTCOMINGS IN TROPICAL CONVECTION SEVERELY LIMIT THE REPRESENTATION OF KEY PHYSICS IN WEATHER & CLIMATE MODELS

- DIURNAL CYCLE - STRONGEST “FORCED” SIGNAL IN THE CLIMATE SYSTEM.
- SYNOPTIC WAVES AND EASTERLY WAVES, INCLUDING DEVELOPMENT & EVOLUTION OF HURRICANES AND TROPICAL CYCLONES
- MADDEN-JULIAN OSCILLATION (MJO) AND OTHER LARGE-SCALE CONVECTIVELY-COUPLED WAVES
- MONSOON VARIABILITY, INCLUDING ONSET AND BREAK ACTIVITY.
- TROPICAL MEAN STATE, INCLUDING ITCZ AND DISTRIBUTIONS OF RAINFALL OVER OCEANS & CONTINENTS

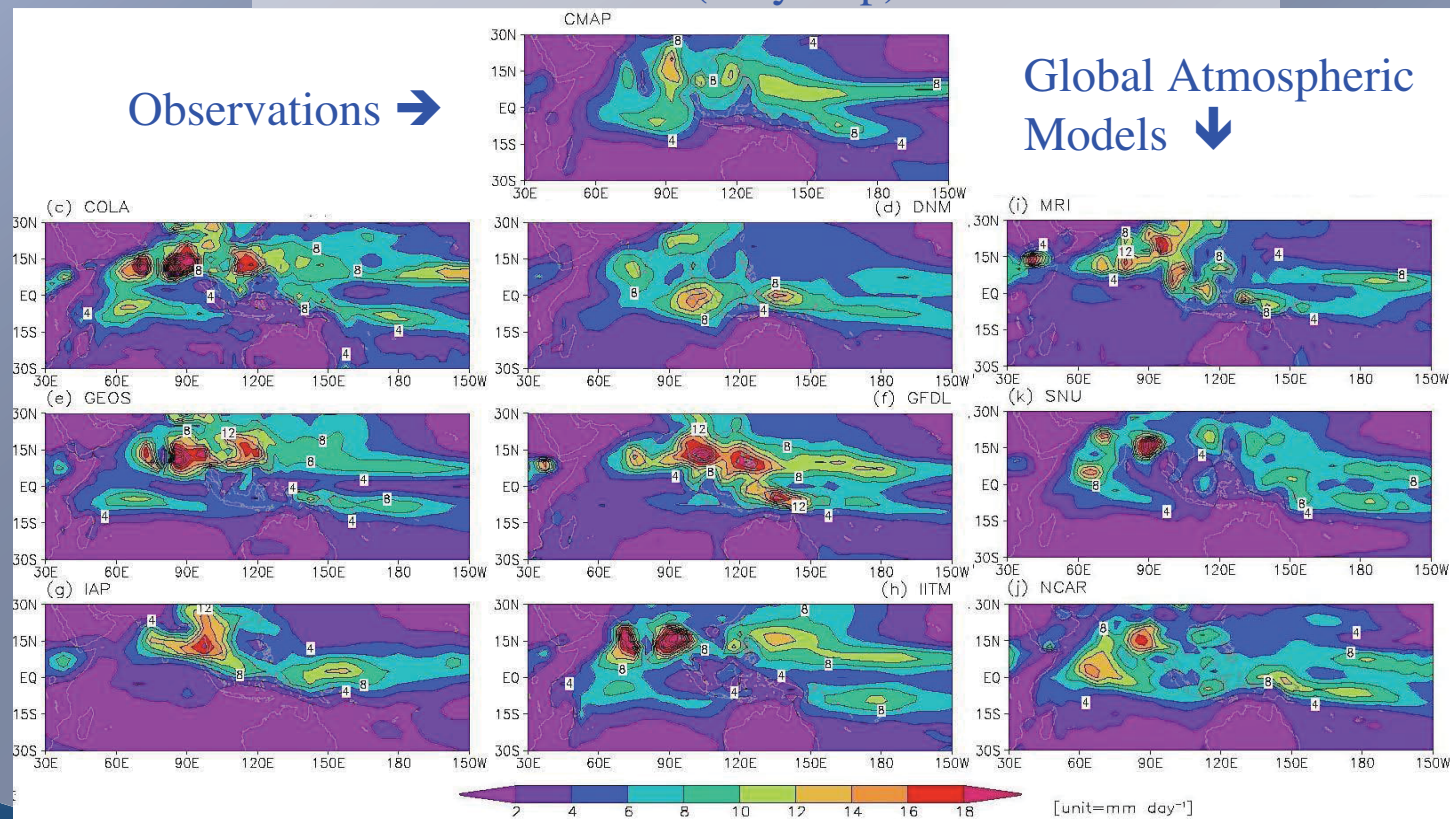


Dominant Convectively-Coupled Tropical Waves Projected onto OLR Anomalies. Wheeler and Weickmann, 2001

NEW AND/OR CONSOLIDATED APPROACHES ARE NEEDED, APPROACHES THAT ARE ABLE TO COORDINATE AND FOCUS THE VAST NEW RESOURCES DEVELOPED IN RECENT YEARS . PAST ATTEMPTS INCLUDED PROGRAMS SUCH AS FGGE, GATE & TOGA COARE.

OUR NEW APPROACHES SHOULD COMBINE THE STRENGTHS OF SUCH EFFORTS WITH OUR VASTLY EXPANDING OBSERVATIONAL INFRASTRUCTURE & THE TREMENDOUS GAINS SEEN IN COMPUTATIONAL POWER.

Mean Asian Summer (May-Sep) Monsoon Rainfall



AS A CONTINUING EFFORT TO ADDRESS THE CHALLENGE OF ORGANIZED TROPICAL CONVECTION, WCRP, THORPEX AND ICTP HOSTED A WORKSHOP* WITH THE FOLLOWING OBJECTIVES:

- *To review our fundamental understanding of the initiation and maintenance of organized tropical convection ... and how its simulation in weather and climate prediction models can be improved leading to advances in predictive capability;*
- *To review the state of knowledge and future directions in observing, simulating, modelling and predicting the MJO and its socio-economic implications; and*
- *To prepare a Workshop report that includes priorities for THORPEX/WCRP research and forecast demonstration projects.*

At this 5-day, 70+ participant workshop, the following recommendation was drafted:

(WCRP/THORPEX) YEAR OF COORDINATED OBSERVING, MODELING AND FORECASTING OF ORGANIZED TROPICAL CONVECTION AND ITS INFLUENCES ON PREDICTABILITY.



***THORPEX/WCRP/ICTP Workshop: Organisation and Maintenance of Tropical Convection and the Madden Julian Oscillation, ICTP, 13-17 March 2006, Trieste, Italy.**
http://cdsagenda5.ictp.trieste.it/full_display.php?smr=0&ida=a04205#

YEAR OF COORDINATED OBSERVING, MODELING AND FORECASTING

THE PAST 10-15 YEARS HAVE MARKED EXTRAORDINARY GAINS IN OBSERVATIONS, MODELING AND TECHNOLOGICAL INFRASTRUCTURE. IN PARTICULAR:

- SUBSTANTIAL PROGRESS TOWARDS GOOS
- ARRIVAL OF EOS-ERA OF SATELLITE OBSERVATIONS
- ARRIVAL OF GLOBAL CLOUD-SYSTEM RESOLVING MODELS

WE HAVE COME TO APPRECIATE:

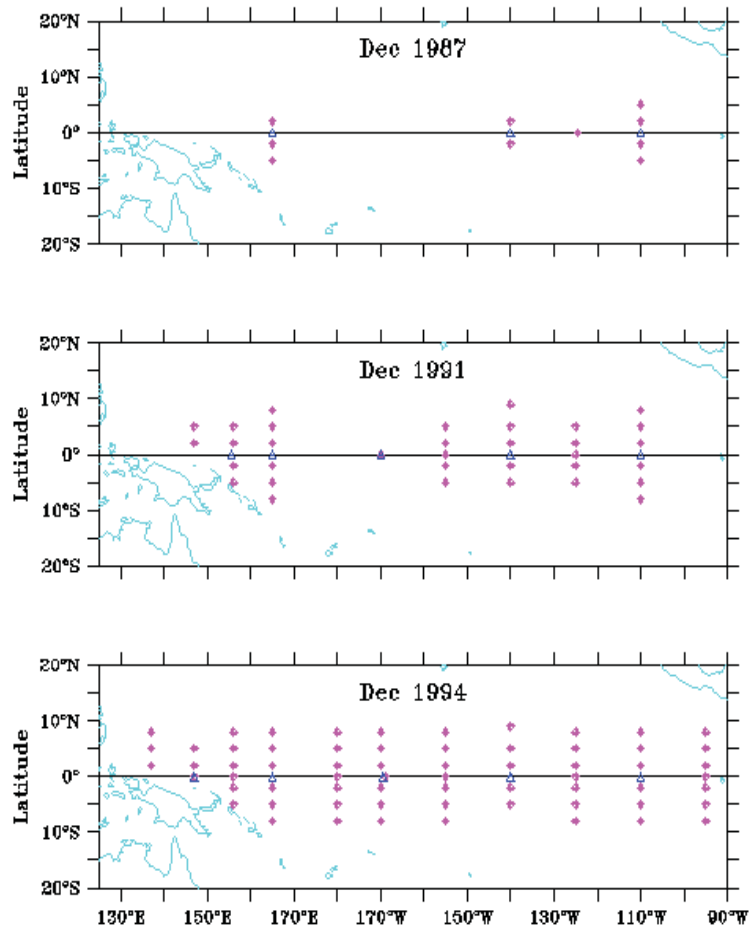
- SHORT-TERM WEATHER ERRORS <-> LONG-TERM CLIMATE BIASES

THESE ADVANCES IN RESOURCES, TECHNOLOGY AND THINKING NEED TO BE, AND CAN BE, WOVEN TOGETHER TO MAXIMIZE RETURN ON INVESTMENT.

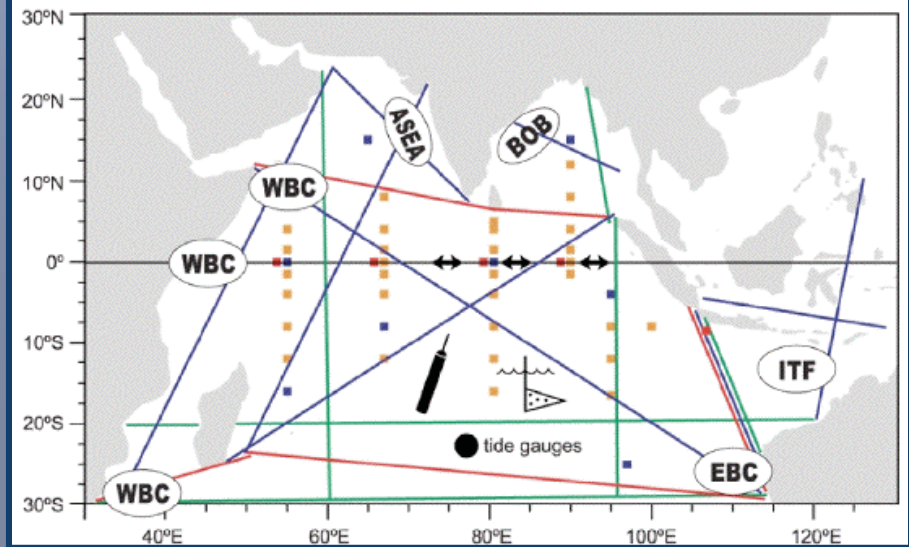


PROGRESS TOWARDS GOOS

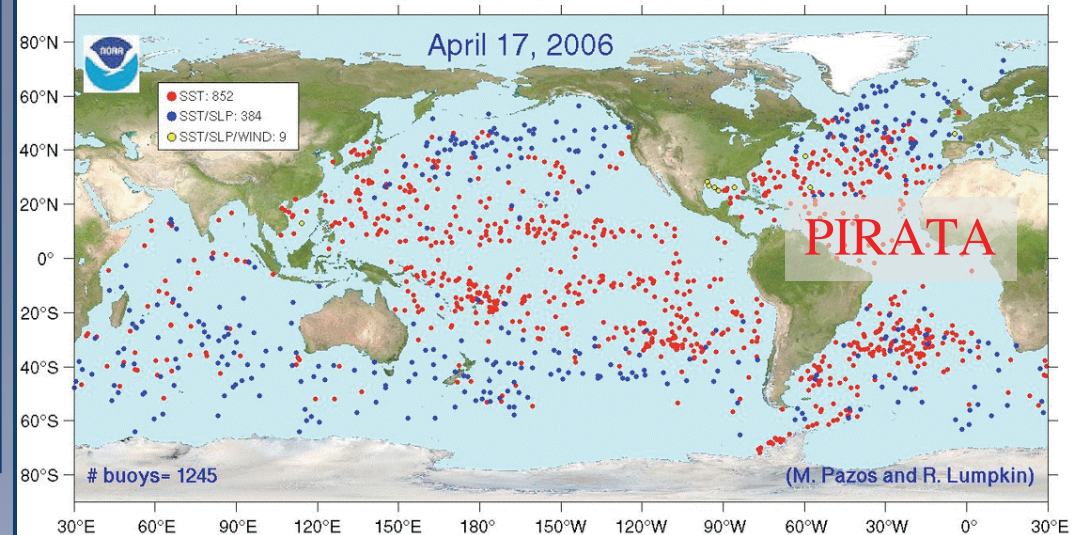
TAO Array



Indian Ocean Integrated Observing System

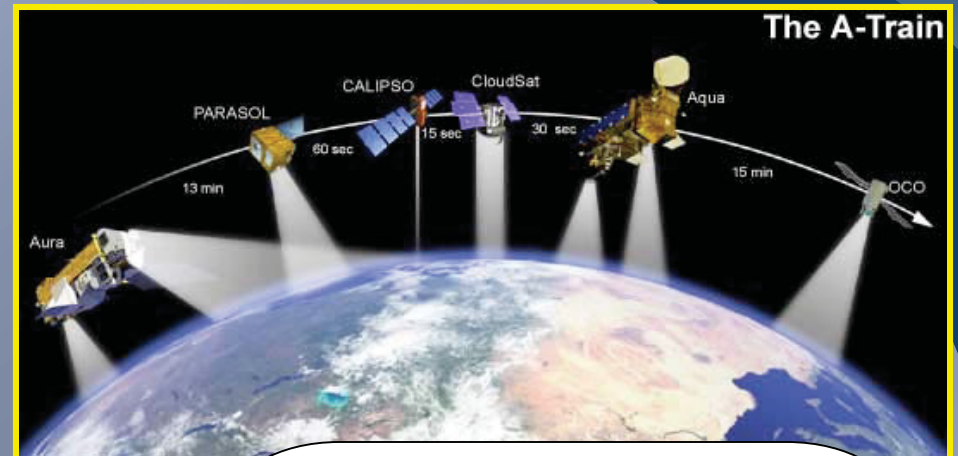


STATUS OF GLOBAL DRIFTER ARRAY



ARRIVAL OF THE EOS-ERA OF SATELLITE OBSERVATIONS

Merely a sample, consider where we were 10-15 years ago...



TOPEX: sea surface height

QuickScat: ocean surface winds

TRMM: precipitation

TMI: sea surface temperature w/clouds

AIRS: temperature and water vapor profiles

CloudSat: cloud profiles

Calipso: aerosol/thin-cloud profiles

AMSRE: ocean precip, water vapor, liquid water

MLS: upper tropospheric water vapor, cloud ice, temperature

CERES: TOA and surface radiative fluxes

MODIS: cloud characteristics, ocean color, land characteristics

AURA platform: atmospheric composition/chemistry

MISR: aerosol and cloud structure

COARE: 120-day IOP
~6000 soundings

Tropical Soundings:

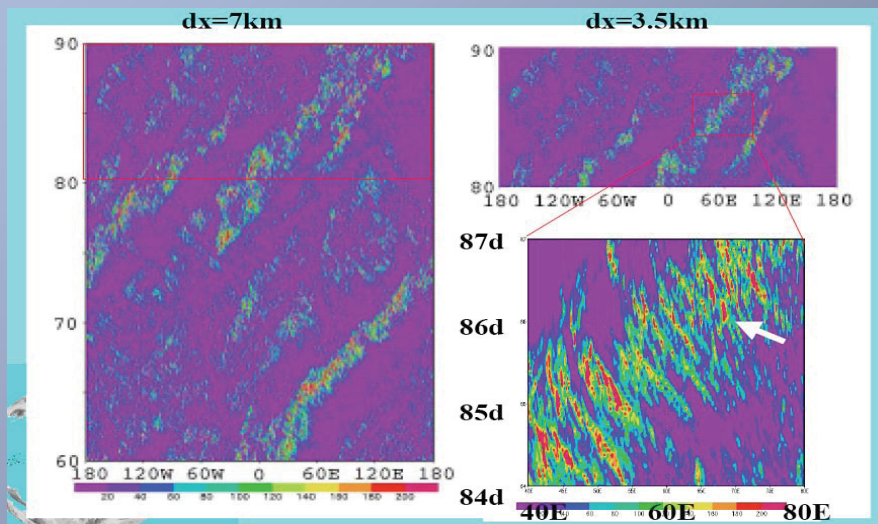
AIRS: ~100,000/day

CloudSat: ~90,000/day

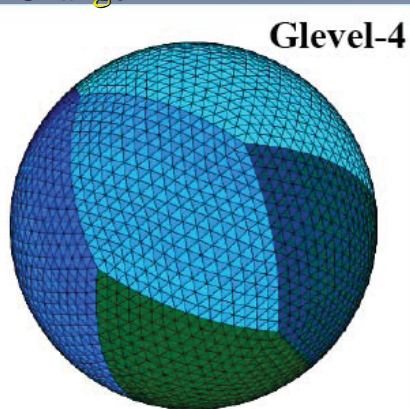


GLOBAL CLOUD-SYSTEM RESOLVING MODELS

Far from a single enterprise anymore...

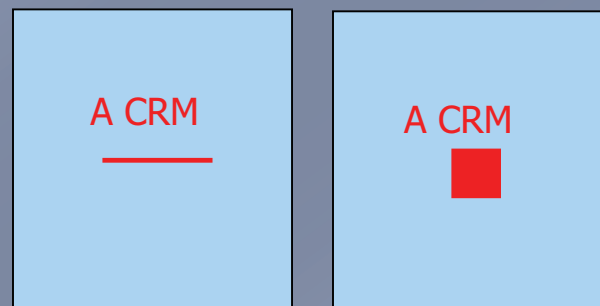


Courtesy Satoh Frontier Research Center for Global Change



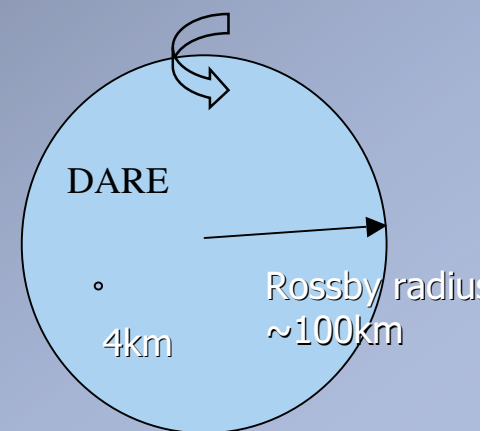
Glevel-9: $\Delta x=14\text{km}$
Glevel-10: $\Delta x=7\text{km}$
Glevel-11: $\Delta x=3.5\text{km}$

MMF; "superparameterization"



A GCM cell

@ CSU, LLNL, GSFC & PNNL

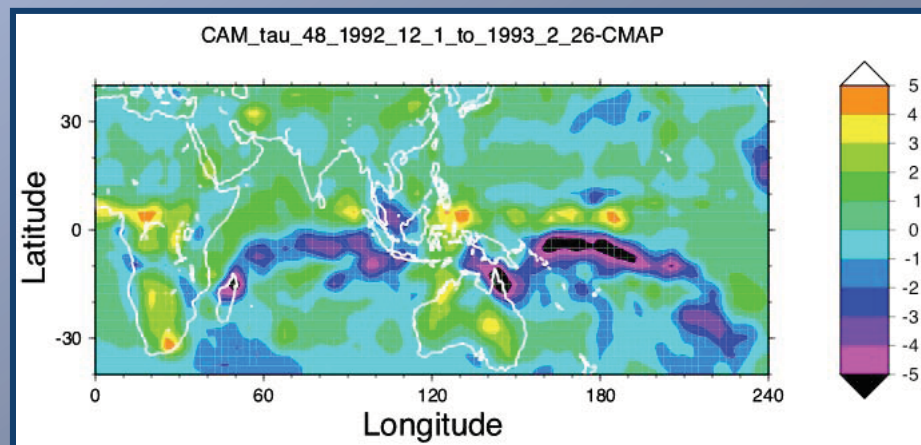


Courtesy Kuang

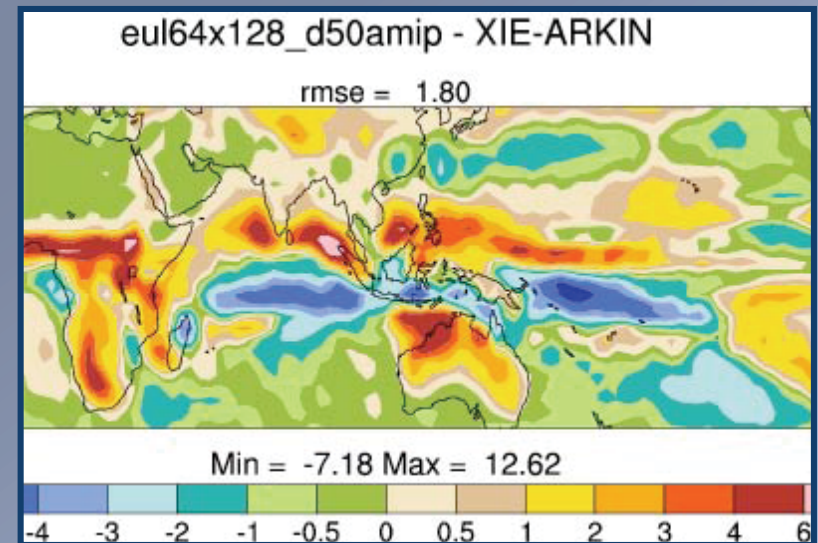
SHORT-TERM WEATHER ERRORS <-> LONG-TERM CLIMATE BIASES

DOE CAPT PROJECT AT LLNL INTEGRATES
CLIMATE MODELS IN WEATHER PREDICTION MODE
PERFECTLY SUITED TO A “FOCUS YEAR” APPROACH*

**NCAR Day 3 Precipitation
Error for DJF 1992-93**



NCAR DJF Climatological Error



**The CAPT project is a joint project of the DOE CCPP and ARM Programs*

Courtesy S. Klein



YEAR OF COORDINATED OBSERVING, MODELING AND FORECASTING OF THE TROPICS

Leveraging the vast new observational datasets and computational resources in conjunction with new / high-resolution modeling frameworks to better characterize, understand, model and forecast multi-scale convective processes/dynamical interactions in the Tropics.

We are in a new era. The Tropical Atmosphere-Ocean Have Never Been So Well Observed.

Proposal:

Timeframe: ~2008 for ~ 1 Year

Region: ~ 40N - 40S

Time Scales: Diurnal to Seasonal

Case Study/Event Identification and Detailed Analyses:

MJO events, convectively-coupled waves, active/break monsoon, typhoon/hurricanes, easterly waves, mesoscale systems, etc.

Central repositories to store/disseminate data as well as information on results, activities, etc.

Leverage/Coordinate existing resources.

By way of coordinated research and incremental \$; No large \$\$\$ required.

YEAR OF COORDINATED OBSERVING, MODELING AND FORECASTING OF THE TROPICS

- **Satellite Resources** : Already Discussed
- **Field Programs:** Leverage Overlapping Activity and Maximize Impact & Investment: IO, AMMA, TC4, CTCZ, THORPEX, TACE, VOCALS, etc
- **(Re-)Analyses and Forecasting/Hindcasting:** Operational & Re-Analyses, “Seamless” Global Predictions, Limited Domain Forecasts: *Examine forecast error growth to investigate model parameterization shortcomings as well as initial condition errors, with special emphasis on identified cases/events.*
- **Model Simulations:** global and regional CRM, channel models, AGCMs, CGCMs: *improving understanding and modeling of multi-scale organized convection, and transitioning knowledge into improved parameterizations and forecasting capability.*
- **Focus Groups and Workshops:** A series of international workshops designed to identify the most pressing and tractable problems from the Focus Year, design and coordinate activity, share modeling strategies and successes, report results and iterate on additional problems or Years.

YEAR OF
COORDINATED
OBSERVING,
MODELING AND
FORECASTING OF
THE TROPICS

Forecast
Simulate
Assimilate

ERRORS

Compare
With
Observations

Improve
Model, ICs,
Methods

2007

2008

2009

2010

diurnal cycle, synoptic systems,
intraseasonal, annual cycle, mean,
mesoscale-to-planetary-scale organization



THESE IDEAS IN THIS PRESENTATION INCORPORATE THE THOUGHTS AND EFFORTS OF MANY. THE LIST BELOW HIGHLIGHTS THOSE THAT HAVE PROVIDED INPUT AS WELL AS A NUMBER OF THOSE THAT HAVE BEEN BRIEFED AND/OR EXPRESSED SOME LEVEL OF INTEREST.

Trieste Workshop Organizers: J. Slingo (Reading University), F. Molteni (ICTP), M. Moncrieff (NCAR), M. Shapiro (NOAA) and Participants

WCRP - Director

THORPEX (M. Shapiro, I. Szunyogh, H. Davies, H. Wernli, D. Parsons, etc)

International CLIVAR SSG and a number of other Panel Chairs

GEWEX - Chair, Director of IGPO

CLIVAR Asian-Australian Monsoon Panel

WOAP - Chair

WMP - Chair

AIRS Satellite Mission (B. Lambrigtsen/E. Fetzer)

CloudSat Satellite Mission (G. Stevens)

MLS Satellite Mission (J. Waters/N. Livesey)

MISR Satellite Mission (D. Diner)

F. Vitart (ECMWF)

M. Reinecker/S. Schubert (GMAO/NASA)

W. Higgins (CPC/NCEP/NOAA, Director Climate Test Bed)

S. Klein (ARM/DOE, CAPT Project)

P. Dirmeyer (COLA/NSF)

R. Dole (CDC Director/NOAA, Co-Chair, CCSP CVC IWG)

D. Anderson (NASA, Program Director)

J. Huang (NOAA, Program Director)

G. Schmidt (GISS/NASA)

C. Jakob (BMRC, GCSS Chair)

G. Leptoukh (Data & Inform/GSFC/NASA)

Thorpex IG10 *Weather prediction on sub-seasonal time scales* Mailing List

